Pertanika J. Soc. Sci. & Hum. 7(2): 111 - 119 (1999)
ISSN: 0128-7702
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Demand for Fish and its Substitutes in Malaysia: Evidence of Habit Formation and Structural Change

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Keywords: demand, fish, habit formation, structural change

ABSTRAK

Kajian ini membincangkan isu perubahan citarasa pengguna terhadap permintaan ikan dan daging di Malaysia. Kedua-dua kesan tabiat berterusan dan perubahan struktur mengenai kegemaran pengguna terhadap ikan dan penggantinya dikaji secara empirik dengan menggunakan data dari 1960 hingga 1990 dan pendekatan Sistem Permintaan Hampir Unggul (AIDS). Dengan menggunakan model dinamik AIDS, terdapat pembentukan tabiat yang berterusan di dalam permintaan terhadap ikan, ayam dan khinzir tetapi kuantiti daging lembu dan daging kambing yang dibeli dimasa lepas akan mengurangkan agihan belanjawan semasa ke atas daging-daging tersebut. Perubahan struktur mengenai kegemaran pengguna diuji dengan menggunakan prosedur CUSUMSQ dan didapati tiada terdapat selangan struktur bagi persamaan ikan. Ini menunjukkan bahawa citarasa pengguna tidak berubah terhadap ikan, konsisten dengan anggapan a priori, tetapi penduduk yang lebih peka kepada cara hidup yang lebih sihat, mengubah kegemaran mereka daripada daging merah dan sekarang meminta lebih banyak daging putih, termasuk ikan.

ABSTRACT

This paper addresses the issue of changes in consumers' tastes in the demand for fish and meat products in Malaysia. Both, habit persistent effect and structural change in consumers' preferences towards fish and its substitutes are empirically examined using data from 1960 to 1990 with an Almost Ideal Demand System (AIDS) approach. In the dynamic AIDS model, it was found that there was a pervasiveness of habit formation in the demand for fish, chicken and pork but the amount of beef and mutton purchased during the last period tends to lower current budget allocation on these meat products. The structural change in consumers' preferences were tested using CUSUMSQ procedure and it was found that there was no structural break in the fish equation. This indicates that consumers' tastes do not change with respect to fish, consistent with a priori expectation, but the more health-conscious population are changing their preferences away from the red meats and currently demanding a bigger amount of white meat, which includes fish.

INTRODUCTION

Malaysia is a comparatively small, multi-racial and multi-religious country in Southeast Asia. For the past several years, the Malaysian economy has been growing at the rate of eight per cent per annum. Slightly less than half of its population are Malays, followed by Chinese, Indians and other minority races. The Malays being Moslems cannot eat pork while the Indians being predominantly Hindus are prohibited from consuming beef. Whilst meat-based protein consumption is dependent on the racial and religious fabrics of the population fish is basically acceptable to all irrespective of income levels. Thus, it is only natural to expect that fish tends to dominate over other meat consumption in this country.

Around mid-seventies and early eighties there was a sudden increase in the demand for seafood worldwide. This shift in the consumption pattern was partly attributed to a very important discovery in the medical field on the relationship

between saturated fats and nutrition and health. Seafood was found to be particularly healthy because of its Omega-3 fatty acids which was often associated with reduced heart disease and neurological disorders (Lees, 1988). The discovery has affected the pattern of meat consumption worldwide including many of the developing economies.

The importance of fish products (white meat) in the consumer's diet and budget share is not entirely new in Malaysia. Being a relatively poor country then and maritime in nature, fish has naturally been a life line for the majority of its population. In 1990 per capita fish consumption was estimated at 37.5 kg per annum while per capita consumption for beef, poultry, mutton and pork were relatively lower at 3.49kg, 20.40kg, 0.50kg and 10.29kg, respectively (DVS, 1992). The high per capita consumption of fish relative to other meat products is not only a manifestation of the health concerns but most importantly fish is the cheapest form of protein meat available and acceptable to all races and religions in Malaysia.

Figs. 1 and 2 illustrate the per capita consumption trends for fish and other meats in Malaysia from 1960 to 1990. The summary statistics of these trends are given in Table 1. The most striking feature in these diagrams is the steady increase in the per capita consumption of fish and chicken, both of which are categorized as white meat, while the consumption of other red meats remains steady or even declining. The per capita fish consumption in particular has increased almost threefold since 1960 while chicken consumption has doubled during the same period. One possible explanation for this phenomena is that the relative prices of chicken to beef, and fish to beef have declined over the sampled period. In terms of average budget share, fish captures 57.09% of the consumers' total meat expenditures, pork 32.9%, chicken 13.45% while beef and mutton account for 4.36% and 2.09%, respectively. Coincidentally this consumption pattern is similar compared to those in other countries of the Pacific rim region where the principal product is unequivocally fishery products (Capps et al., 1994).

Since the introduction of the almost ideal demand system (AIDS) by Deaton and Muellbauer (1980), many applications of this model have been made to analyze consumer demand for food. These have included studies

TABLE 1
Average per capita consumption and budget shares for fish and meat products in Malaysia, 1960-1990

Commodity	Average per capita consumption (kg)	Average budget share of meat products (%)
Fish	37.35	57.09
Chicken	9.84	13.45
Pork	15.88	32.9
Beef	1.67	4.36
Mutton	0.65	2.09

by Blanciforti and Green (1983), Eales and Unnevehr (1988), Fulponi (1989), Moschini and Meilke (1989), and Chalfant et al. (1989). Several studies have also been carried out in this region using the same model. Examples are studies by Ahmad Zubaidi and Zainal Abidin Mohamed (1993) and Nik Mustapha et al. (1994). Except for Blanciforti and Green (1983), all these studies have applied the linear approximation of AIDS model (LA/AIDS) by using the Stone's index to obtain price and income elasticity estimates.

Most of these applications however utilized static demand model (static AIDS) in which consumers are assumed to fully and instantaneously adjust their optimal purchase of commodities to current changes in prices and income. One problem of the static AIDS model is that it ignores the features of persistence in habits and the possibility of dynamic behavior in consumer demand. It has been suggested that inappropriate specification of the dynamic behavior may account for the rejection of theoretically based demand conditions (Deaton and Muellbauer, 1980). Several studies that have successfully incorporated this habit formation problem were Blanciforti and Green (1983), Burton and Young (1992) and Molina (1994), among others.

Another important aspect of demand studies is the issue of structural change in demand for fish and meat products. Statistical instability is often interpreted to mean that some underlying parameters in the utility function have changed. For example, changes in own-price elasticity (taste) or income elasticity affect the stability of the demand equations. Structural instability may result in model that may be correct in one sample period but not in another period. Structural change in Malaysian fish and meat

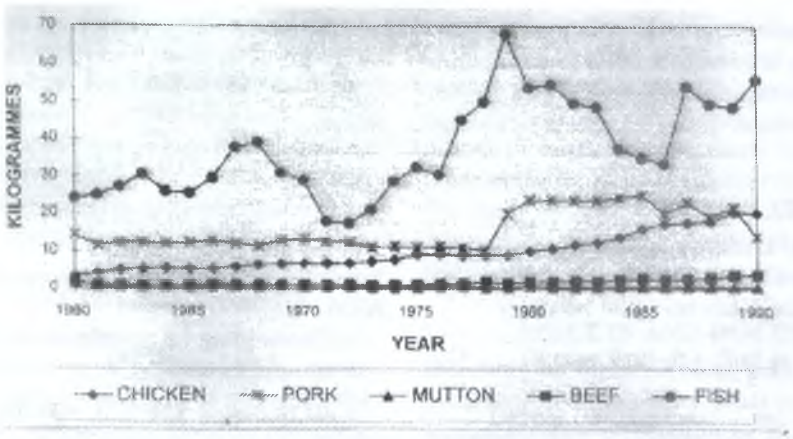

Fig. 1. Per capita consumption for fish and meat, 1960-1990

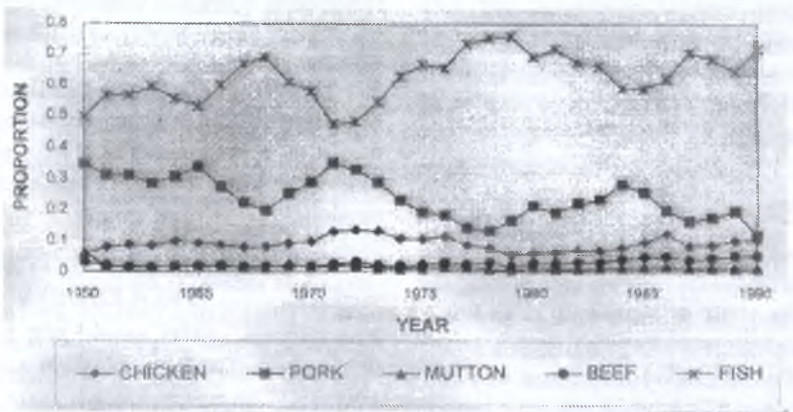

Fig. 2. Budget share for fish and meat, 1960-1990

demand is an important concern because such changes may necessitate corresponding changes in the fish and meat industry. The industry's responses however should be based on sound economic modeling and economic forecast. Models that do not explicitly account for the changing nature of fish and meat demand may be inappropriate, and thus may suggest industry changes that are inconsistent with economic reality. Previous studies that dealt with this issue using different statistical approaches include Martin and Porter (1985), Chalfant and Alston (1988), Moschini and Meilke (1989), Chen and Veeman (1991), Burton and Young (1992) and Edwards (1992). However, the results reported in these earlier studies were mixed.

No previous studies have so far been carried out to investigate these issues in this part of the world. This study is believed to be the first attempt in this country to address such research which undoubtedly can be very useful towards understanding consumers' behavior in many developing countries concerning demand for protein-based meats. The objective of this paper is therefore two folds: The dynamic form of AIDS that incorporates a habit effect in the consumer expenditure function will first be estimated empirically. The purpose is to examine whether this specification yields empirical results that are consistent with the economic theory of consumer behavior. The other objective is to demonstrate evidence of structural change in the demand for fish and meat products, to assess whether or not consumers' preferences (tastes) towards fish and other meat products have changed over the past three decades.

This paper is organized as follows. Section two discusses the specification of dynamic AIDS model. This is followed by the description of the data used in the study and the estimation

procedure. A brief note on the testing for structural change is given in section four. Section five presents the empirical results and discussion while the last section provides the concluding comments.

MODEL SPECIFICATION

The Almost Ideal Demand System developed by Deaton and Muellbauer (1980) as expressed in expenditure share form is:

$$S_i = \alpha_i + \sum_j \gamma_{ij} \ln P_j + \beta_i (\ln E - \ln P) \qquad (1)$$

where

- i, j = 1, ..., n refers to meat groups
- Si = the expenditure share of the ith meat group
- Pj = prices
- E = total expenditure on all commodities in the system, and
- α_i, β_{ij}, β_i = demand parameters to be estimated.

In equation (1), P is a price index defined by

$$\ln P = \alpha_0 + \sum_k \alpha_k \ln P_k + \frac{1}{2} \sum_j \sum_k \gamma_{jk} \ln P_k \ln P_j \qquad (2)$$

To be consistent with the fundamental postulates of demand theory, the following conditions must hold in terms of parameter restrictions:

$$\Sigma\alpha_i = 1, \ \sum_i \gamma_{ij} = 0, \ \Sigma\beta_i = 0 \text{ (adding-up)} \qquad (2a)$$

$$\sum_j \gamma_{ij} = 0, \text{ (homogeneity)} \qquad (2b)$$

$$\gamma_{ij} = \gamma_{ji} \text{ (symmetry)} \qquad (2c)$$

The standard AIDS specification in (1) is often described as static AIDS.

To incorporate consumption habit variables into the AIDS model, the "dynamic translating" procedure proposed by Pollak (1970) and Pollak and Wales (1981) is adopted here. Following this procedure, the original demand function is replaced by a new system that contains translating parameters, and it is assumed that only the (i parameters depend on the habit persistence variables. Applying this procedure to the AIDS model and specifying the linear dynamic translating parameter as $\alpha_i = \alpha_i^* + d_i q_{it-1}$, where di is the coefficient that measures the impact of previous consumption on the current expenditure share of meat type i, the habit persistence version of the AIDS model becomes:

$$S_i = \alpha_i^* + d_i q_{it-1} + \sum_j \gamma_{ij} \ln P_j + \beta_i (\ln E - \ln P), \ i, j = 1..., 5 \qquad (3)$$

where

$$\ln P = \alpha_0 + \sum_j (\alpha_i^* + d_i q_{it-1}) \ln P_j + \frac{1}{2} \sum_i \sum_j \ln P_i \ln P_j \qquad (4)$$

Equation (3) is popularly known as the dynamic AIDS.

The adding-up condition in the modified system applies if:

$$\Sigma\alpha_i^* = 1, \ \Sigma \gamma_{ij} = \Sigma \beta_i = \Sigma d_i q_{it-1} = 0 \qquad (5)$$

As in the case of the original AIDS model, the adding up restrictions hold only locally. The restriction $\Sigma d_i q_{it-1} = 0$ requires that at least one of the d_i is negative. While a positive sign indicates habit persistence, a negative sign implies inventory depletion effects. The condition of homogeneity and symmetry remain as $\Sigma \gamma_{ij} = 0$ and $\gamma_{ij} = \gamma_{ji}$, respectively. The habit persistence extension adds n parameters to the static AIDS model.

THE DATA AND ESTIMATION PROCEDURES

The dynamic AIDS model will be estimated in this paper. The annual time series data from 1960-1990 on prices for fish and four other meat groups namely chicken, pork, beef and mutton, and income were used in this study. Consumption figures were obtained from the Department of the Veterinary Services (DVS), while data on prices were obtained from various Federal Agricultural Marketing Authority (FAMA) bulletins. Population, income and consumer price index (CPI) were collected from various Malaysia Plans and Economic Reports. All retail prices and income data were deflated by CPI (1980=100). The per capita consumption figures were derived by dividing the total consumption for fish and each of the other meat groups with total consuming population.

The AIDS system summarized in equation (3) is non-linear in parameters. In order to permit this equation to be expressed in linear form equation (4) is often replaced by an index developed by Stone (1953). The index is:

$$\ln P^* = \sum_{k=1}^{n} \overline{w}_k \log P_k \qquad (6)$$

where $\overline{w}_k$ is the mean of the budget share of the kth commodity.

In this paper, the dynamic AIDS model with homogeneity and symmetry restriction imposed was estimated using the Zellner's Seemingly Unrelated Regression (SUR) method.[1] This permits cross equation restrictions to be imposed and with iterative solutions, estimates are Maximum Likelihood. The mutton equation was deleted due to the adding-up restrictions.

TEST OF STRUCTURAL CHANGE

There have been many developments which could have resulted in a systematic change in the demand for fish and meat. For example, the attitude of some consumers towards red meat appears to have changed following the discovery of the relationship between saturated fats and health. The health concerns may have produced a shift in fish and meat preferences. In addition, recent developments in the fast-food industry, for example, have introduced new forms of products available to consumers and this may have directly affected the demand for fish and meat.

In this study we examined the stability (or constancy of parameters) of the meat demand equations using tests based on recursive residuals introduced by Brown, Durbin and Evan (1975). The testing was undertaken using single equation method to avoid the spillover of any misspecification from one equation to another. The approach has the advantage over the others (for example, Chow tests) since it does not require prior knowledge of the shifts but tests for the presence of such occurrence over the sample period.[2]

Briefly, the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) are based on the one-step-ahead forecast errors derived using recursive updated parameter estimates. Accordingly, a change in the structure overtime will result in the recursive residuals to have non-zero mean. The CUSUM and CUSUMSQ of these residuals are used to test for structural change. If the plot of the CUSUM or CUSUMSQ sample path moves outside critical region, and in this case 5% significant level, the null hypothesis of stability overtime of the intercept and slope parameters is rejected (assuming the model is correctly specified).[3] In this study we only report the CUSUMSQ since it is known to be more powerful than the CUSUM test.

RESULTS AND DISCUSSION

Estimates of the structural parameters for the dynamic AIDS model are given in Table 2. Some very interesting results can be summarized from this table. Nineteen of the thirty coefficients estimated are significantly different from zero and the minimum budget shares, α_i, are all between zero and one for each meat type, indicating satisfactory fit. The coefficient β_i are all negative and highly significant for each meat type except mutton. This implies that with the exception of mutton, fish and all other meat products are necessities.

The Durbin-Watson (D.W.) statistics in all except the pork equation are quite high, suggesting that serial correlation is not a problem. The low D.W statistic in the pork equation may suggest some sort of misspecification problem. We also compare the results of dynamic AIDS model with the static AIDS model. Based upon likelihood ratio test, it was found that the dynamic specification is preferred over the static model. The R^2 values for the fish, chicken, pork and beef equations are 0.87, 0.93, 0.86 and 0.86, respectively, indicating that the model performs reasonably well in terms of explanatory power. This suggests that the AIDS model with habit formation variable (i.e. the Dynamic AIDS) is an acceptable specification of the demand model for meats.

It is also interesting to note that the habit persistence variable, d_i, are positive and statistically significant for fish, chicken and pork

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[1] The demand restrictions were tested using the log-likelihood ratio tests. In general the results obtained reject these restrictions. At conventional significant levels, these restrictions were imposed in the final estimations of the dynamic AIDS model.

[2] A major weakness of this approach is that it is difficult to distinguish between the effects of true structural change and model misspecification. To overcome this problem we examined alternative specifications such as static, dynamic and dynamic with diagonal autoregressive AIDS models. The results of our preliminary investigations suggest that the dynamic AIDS specification is the preferred model based on conventional standards.

[3] The CUSUMSQ has a beta distribution with mean of (t-k)/(T-K). For more detailed discussion on the test, see Harvey (1990).

but negative and insignificant for beef and mutton. This indicates the pervasiveness of habit formation in fish, chicken and pork but the amount of beef and mutton purchased during the last period tends to lower current budget allocation on these meat products. The significant coefficients on habit persistence variables suggest that this feature has some influence on consumer's budget share allocation for fish, chicken and pork.

The above results concur with some of the previous studies in that the inclusion of consumption habit effect improves the consistency between theory and data. While changes in relative prices, total expenditure and consumers' habit explain some of the variation in fish and meat consumption, a considerable portion of the observed changes in fish and meat expenditure patterns over the past thirty years is also consistent with a structural change in consumer preferences.

The results of the test for structural change in fish and meat demand in Malaysia using the CUSUMSQ procedure are presented in Fig. 3. Using a 5 percent significant level, it is interesting to note that there is no structural breaks in the fish equation. This indicates that there is no structural change in consumer preferences (ie. no change in taste) as far as fish is concerned. Being the cheapest source of protein, fish used to be and continues to be consumed by the vast majority of the population, either in fresh or processed forms. The favorable medical discovery regarding seafood products has not resulted in the change in tastes or preferences as reported in many other studies.

However, structural breaks are detected, as expected, in chicken, beef and pork consumption. For beef in particular, structural breaks occur in the mid-seventies and the later

TABLE 2
Maximum likelihood estimates of dynamic AIDS with for homogeneity and symmetry restrictions

	Fish	Chicken	Pork	Beef	Mutton
γ_{1i}	0.0047				
	(0.25)				
γ_{2i}	-0.0004	-0.032			
	(-0.09)	(-0.69)			
γ_{3i}	-0.0173	-0.0158	0.0096		
	(-1.71)	(-3.29)*	(2.57)*		
γ_{4i}	-0.0061	-0.0060	-0.0100	0.0096	
	(-2.75)*	(-2.37)*	(-3.22)*	(-2.57)*	
γ_{5i}	0.0191	0.0254	0.0034	0.0126	-0.0605
	(0.93)	(3.89)*	(0.22)	(2.31)*	
β_i	-0.0174	-0.0165	-0.0323	-0.0062	0.0724
	(-13.95)*	(-18.79)*	(-12.03)*	(-9.90)*	
d_i	0.0016	0.0009	0.0011	-0.0001	-0.0035
	(7.16)*	(-4.13)*	(3.34)*	(-0.14)	
Constant	0.5703	0.1234	0.2456	0.0408	0.0199
	(18.09)*	(-21.32)*	(-14.80)*	(8.96)*	
D.W.	1.47	1.71	1.07	1.45	
R^2	0.87	0.93	0.86	0.86	

Log-likelihood value = 510.308

Note: t – values in parenthesis
* – significant at 5%
i = 1, 2, ..., 5, where 1 = fish, 2 = chicken, 3 = pork, 4 = beef and 5 = mutton.

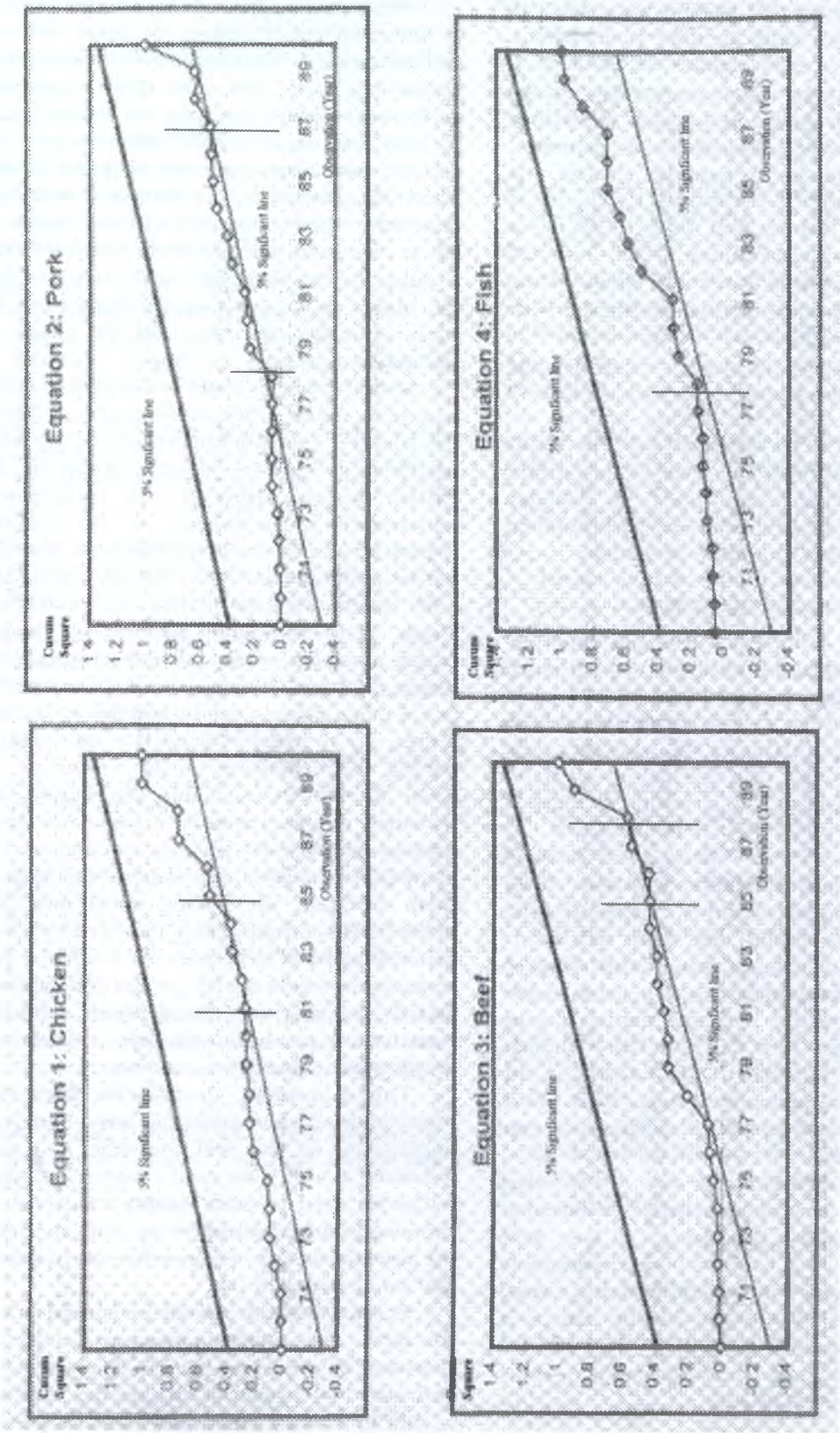

Fig. 3. CUSUMSQ plot for fish and other meats in Malaysia, 1960-1990 (5% significance level)

part of the eighties. For pork, it was evident in the late seventies while the same phenomenon occurred in the early eighties for chicken. It appears that structural changes may have caused the demand for some red meats to decline. Interestingly enough, these trends are consistent with those findings in Australia (Martin and Porter, 1985), the USA (Edwards, 1992) and the Great Britain (Burton and Young, 1992). For example, Burton and Young (1992) reported that there was a reduction in the budget shares for beef, pork and mutton during the late seventies and eighties, but changes in tastes in recent years tended to be in favor of fish and chicken. These changes in fish and meat expenditures and consumption pattern are usually alleged to be associated with increasing health concerns regarding diets. Other possible causes of these changes include the changing nature of the poultry, beef and pork products and the growth of the fast food outlets.

CONCLUSION

This study has addressed at least two important issues in the demand for fish and meat products in Malaysia. Aspects of consumers' tastes were incorporated in the analysis of the Almost Ideal Demand System (AIDS) for fish and other meat products through the inclusion of habit formation variable. The structural changes in the consumer preferences were also tested.

The results of the Almost Ideal Demand System with habit formation (dynamic AIDS) performed creditably from the statistical point of view. It was found that there was strong persistence in the consumption for fish, chicken and pork but past purchases tend to lower budget share allocations for beef and mutton during the period from 1960 to 1990. These findings are consistent with the trends observed in the per capita consumption and budget share where fish, chicken and pork tend to dominate over beef and mutton.

In the structural change tests, it was found that there was no structural change in consumer preferences for fish but changes in taste were observed in chicken, beef and pork consumption. This occurrence is consistent with studies carried out elsewhere, where the health conscious populations are now consuming lesser amount of red meat products but an increasing quantity of white meat such as fish.

Both results suggest several point of interest to Malaysian policy makers, planners and fish and meat traders. The consumers are persistently demanding more fish and their tastes and preferences towards fish have not changed over the past three decades. Fish remains as the most popular meat item and has acquired a very important position in the diet. It is therefore imperative that continuous and stable supply of fish at reasonable price be made available to the population. Any short fall in the supply of fish will bound to have a negative impact on the consumer's diet, nutrition and the health of Malaysians at large.

Several strategies could be adopted by policy makers to ensure a sustainable supply of fish in this country. Increase importation of fish from neighboring countries would probably be the easiest option. However this option will unnecessarily put a pressure on the country's already strained balance of payment, and will not be politically and economically viable. The other alternative is to increase fish production locally. This proposition however will further create problems on our already overexploited fishery resources. Increasing fish price and the use of more efficient fishing technology will not redress the problem at hand but unnecessarily putting severe pressure on fish resources. In order to ensure sustainable fish supply, this renewable resources must be managed efficiently. Various management regimes are discussed in many fishery economics literatures and some of them especially the fishing effort reduction measures are currently being instituted by fishery administrators. In some areas the results are very encouraging where the fish production improves and in the long run, these fishery resources conservation measures will help mitigate the growing fish demand in this country.

The movement towards an increased importance of white meats has some important implications on the beef and other red meat industries as well. Our results suggest that these industries need to make quality adjustment in production since consumers are concerned with the potential danger of large intake of cholesterol and other saturated fats.

Further research should be carried out in this aspect using other approaches. Consumers' responses to price and income changes before and after the structural change has occurred should be studied before any effective policies

regarding fish and meat industries be drawn up and implemented to satisfy the presently more effluent and health-conscious consumers in this country.

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(Received: 30 October 1996)